Original Article

Placental Thickness Measurement by Ultrasonography and Its Correlation with Gestational Age of Fetus in the Manipuri Population

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Abstract

Purpose: The study was done to measure the placental thickness (PT) in pregnant women and find its correlation with the gestational age (GA) of the fetus by ultrasonography. Comparisons were also made with the other fetal biometry parameters, and baseline data were generated with respect to the gestational weeks and placental position. **Materials and Methods:** The study was a cross-sectional one with a sample size of 134 singleton pregnancies. About 11–40 weeks of gestation were studied for the measurement of PT and other fetal parameters. Informed consent was obtained before recording the data on the preformed questionnaire. All measurements were done in mm and during the relaxed phase of the uterus. **Results:** As per the study, PT (in mm) increases with an increase in GA (in weeks) and almost matches it from 12 to 34 weeks of gestation. PT had a strong correlation with GA ($r = 0.966$). The correlation was statistically significant, with a $P < 0.001$. **Conclusion:** Thus, the estimation of the thickness of the placenta at the cord insertion site by means of ultrasonography is a relatively simple, safe, and cheap modality for accurate estimation of GA, fetal growth, and placental abnormalities and thus can significantly affect the management and outcome of pregnancy.

Keywords: *Fetal biometry, gestational age, intrauterine growth restriction, placenta, ultrasonography*

Introduction

The placenta is the organ that facilitates nutrient and gas exchange between the maternal and fetal compartments. As the fetus begins the 9th week of development, its demands for nutritional and other factors increase, causing major changes in the placenta.[1] The placenta begins to develop from the chorion frondosum and decidua basalis in the 8th week of intrauterine life. Sonographically, the chorion frondosum can be distinguished by its thickness from the thinner, opposing chorion laeve as early as 8–9 weeks. Starting at about 10 weeks, the placenta is clearly distinguishable from its surroundings as a disk-shaped organ.[2] The placental thickness (PT) can be used to estimate gestational age (GA). GA is frequently over or underestimated, as the conventional gestational estimation is based on the last menstrual period (LMP) and on ultrasonography. Many people are unaware of their LMP, and irregular menstruation and ultrasonography are bound to have a bias, thereby posing difficulties in the estimation of GA.[3] Hence, there is a need to explore other parameters that may complement the established fetal biometric parameters in predicting GA, especially as pregnancy advances to the third trimester. Placenta has been noted to increase as pregnancy advances in age,[4] and so the study aims at finding the correlation between PT and GA measured by ultrasonography.

Materials and Methods

The present study was a cross-sectional one, and the study setting was in the Departments of Anatomy and Radiodiagnosis of Regional Institute of Medical Sciences, Imphal, India. The study duration was 2 years and 134 pregnant women between 20–40 years of age group and 11–40 weeks of gestation were included in the study. Confidentiality was maintained. Pregnant Manipuri women who knew their LMP and had singleton pregnancies were only recruited. Cases having medical, gynecological, obstetrical, placental pathologies, and multiple pregnancies were excluded. Informed consent from the respective individuals was taken. Samsung Medison HS70A (SN: S14YM3HJ900003A) and Samsung Medison SONOACE X8 version (SN:

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B23508300008323) with a 3.5 MHz curvilinear transducer probe [Figure 1] were used for transabdominal ultrasound and data were collected from the patient profile displayed on the monitor of the machine. The PT, in mm, was measured at the level of the cord insertion site, which can be seen as colored signals in the Doppler [Figure 2]. The transducer was placed in a manner that it could stay perpendicular to both the choric and basal plates. The myometrial and subplacental veins were excluded from the study, and all the placental measurements were taken during the relaxed phase of the uterus as contractions can suddenly increase the PT. Biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC) were measured as done routinely. Data were collected in a pretested pro forma. The analysis was performed using the Statistical Package for the Social Sciences, SPSS 21.0 version, and Microsoft Word and Excel were used to generate graphs, tables, and charts.

Results

In the present study, 10 (7.46%) were in the first trimester (<14 weeks), 64 (47.76%) in the second trimester (14–27 weeks), and 60 (44.78%) were in the third trimester (>27 weeks) of pregnancy. In different trimesters, the PT was measured, and the GA was found to be having a correlation with that measured by ultrasonography. The PT was 13.2 mm, 19.2 mm, and 31.36 mm at 13 weeks 4 days, 19 weeks 3 days, and 37 weeks and 6 days of gestation, respectively, as measured in the ultrasonography [Figures 2-4]. The total number of measurements ranged from a minimum of 1 to a maximum of 12 for each week of GA [Figure 5]. Table 1 shows that the mean PT and standard deviation (±SD) in <14 weeks were 12.90 mm and (±1.26), respectively. From 14 to 27 weeks of gestation, the mean PT was 21.56 mm and (±SD) was (±4.56). For GA of >27 weeks, the mean PT and (±SD) value was 34.67 mm and (±4.21). The mean values of PT along with the respective standard deviation were calculated for different GAs from 11 weeks to 40 weeks. It is observed that PT gradually increases from approximately 10 mm at 11 weeks to 41.95 mm at 39 weeks of GA and had a linear relation [Figure 6]. Linear regression model yielding the following equation was developed from the present study Y = a + bX where Y = dependent variable, a = intercept or constant, b = regression coefficient of Y upon X. X = independent variable.

Thus, Y (PT in mm) =0.905 (a) +0.995 (b) × X (GA in weeks) [Figure 7].

Table 2 shows that using Pearson's correlation test, a highly positive correlation between the mean as well as total PT measurements and GA measured by ultrasound was obtained with the value of Pearson's correlation coefficient being (r = 0.966) [Figure 8].

Discussion

In the study done on 750 Nigerian women, Ohagwu *et al*. stated that the maximum PT recorded at the 39th week of gestation was 45.1 ± 6.4 mm with a linear increase in PT in all the other gestational weeks and a strong positive correlation between both.[5] In the present study, the linearity in the increment of PT with GA is found to be similar with maximum PT at 39th week being 41.95 ± 0.57 mm. A positive correlation exists between PT and other fetal biometry parameters such as BPD, FL, AC, and HC with $P < 0.001$. The correlation coefficient between PT and GA was found to be 0.98, and the increase in thickness was 14.6 mm at 11 weeks to 38.9 mm at 40 weeks as per a study.[6] In the present study, also similar significant positive correlation was found between PT and all the other fetal biometry parameters. Thickness increased from 10 mm at 11 weeks to 38.2 mm at 40 weeks with a correlation coefficient of 0.96 bearing striking similarities with the mentioned study. Hellman

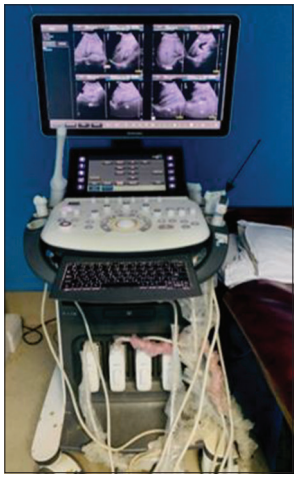

Figure 1: SAMSUNG MEDISON HS70A with 3.5 MHz sector curvilinear transducer probe shown by the black arrow

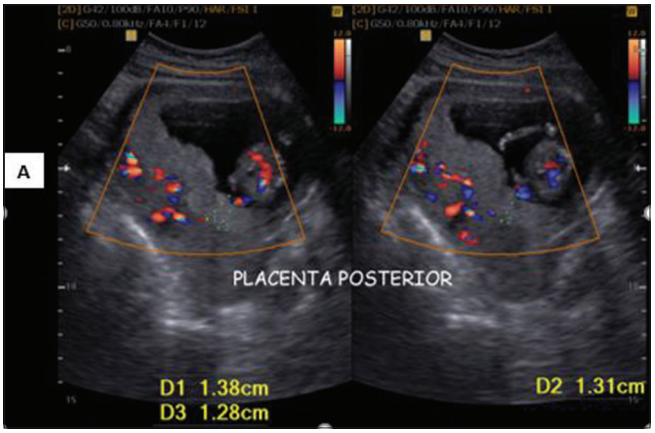

Figure 2: Note that the placental position is posterior and the three measurements are taken to estimate placental thickness. A mean of the three measurements is 13.2 mm. The average gestational age as 13 weeks 4 days by ultrasound which shows striking linear correlation with the placental thickness

Table 1: Mean placental thickness in various trimesters

GA (weeks)	*n* (number of cases)	Mean±SD	95% CI for mean		*F*	*P*
			Lower bound	Upper bound		
<14	10	12.90±1.267	11.99	13.81	204.576	0.000***
14-27	64	21.56±4.560	20.42	22.70		
>27	60	34.67±4.213	33.58	35.76		
Total	134	26.78±8.575	25.32	28.25		

***P<0.001 - Highly significant. F-value obtained from ANOVA test. SD: Standard deviation; CI: Confidence interval; GA: Gestational age

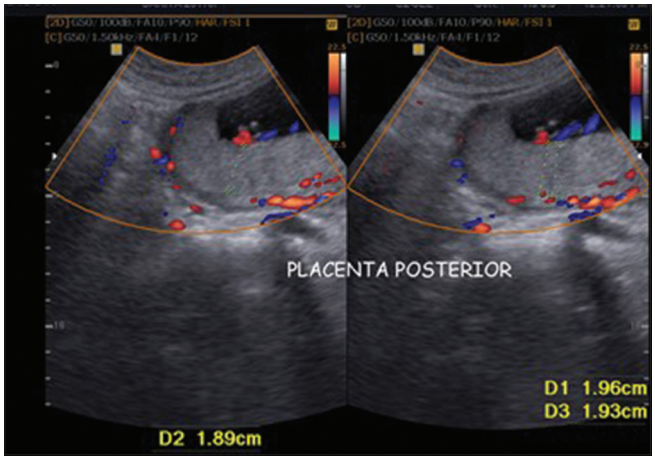

Figure 3: Note that the placental position is posterior, and the three measurements are taken to estimate placental thickness. A mean of the three measurements is 19.2 mm. The average gestational age as 19 weeks 3 days by ultrasound which shows striking linear correlation with the placental thickness

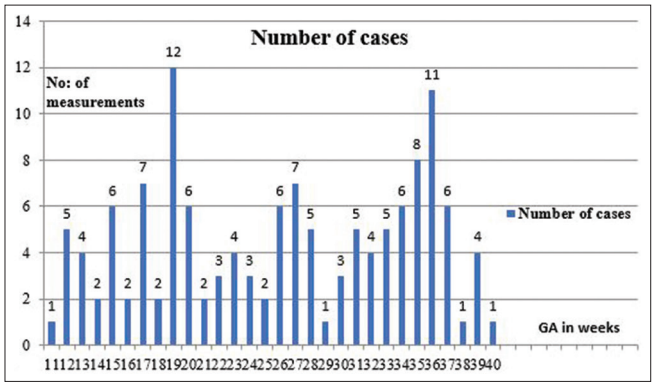

Figure 5: Number of measurements for each gestational age

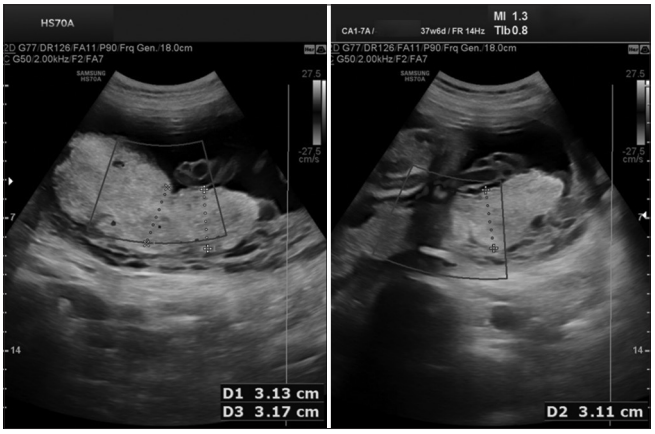

Figure 4: Note that the placental position is posterior, and the three measurements are taken to estimate placental thickness. A mean of the three measurements is 31.3 mm. The measurement has the average gestational age as 37 weeks 6 days by ultrasound

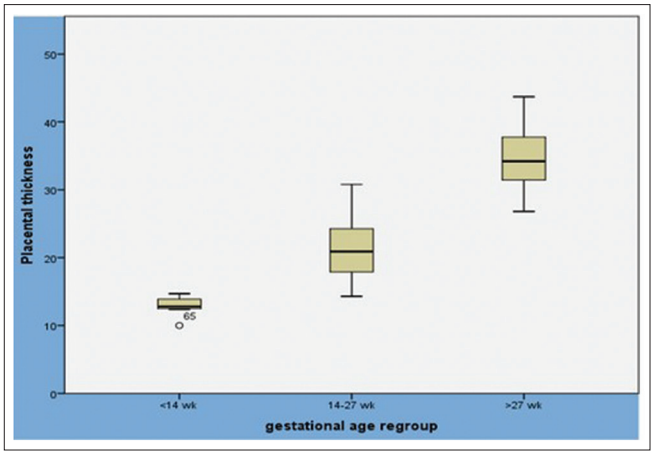

Figure 6: Box plot of gestational age in weeks (trimesters) with mean placental thickness showing their linear relationship

et al.,[7] in their study, explained that placental growth ceases after 37 weeks and the thickness becomes lesser in the 4 weeks. Ahmed *et al.*,[8] in their study, observed that the placenta thickness gradually increased from 15 mm at 11 weeks of gestation to 37.5 mm at 39 weeks. From the 22nd week to the 35th week of gestation, the PT coincided almost exactly with the GA in weeks. In the present study, from 14 weeks to 34 weeks of gestation, the PT in mm almost matched with the corresponding gestational week. After 34 weeks, PT showed variability in the growth pattern with an increase in the 36th and 39th weeks and reduction in the 35th, 37th, 38th, and 40th weeks. It is found that in 93.3% of cases, a thick placenta is associated with cytomegalovirus infection.[9] Since routine ultrasound is done in antenatal cases, the PT can be used as an indicator for suspected cases. This knowledge can be incorporated from subdivisional to tertiary care hospitals. In the present study, however, the maximum thickness was 42 mm, and there were no associated viral infections as per the medical record of the cases.

It is observed that the PT almost matches the GA and a high degree of positive correlation denoted by r = 0.921

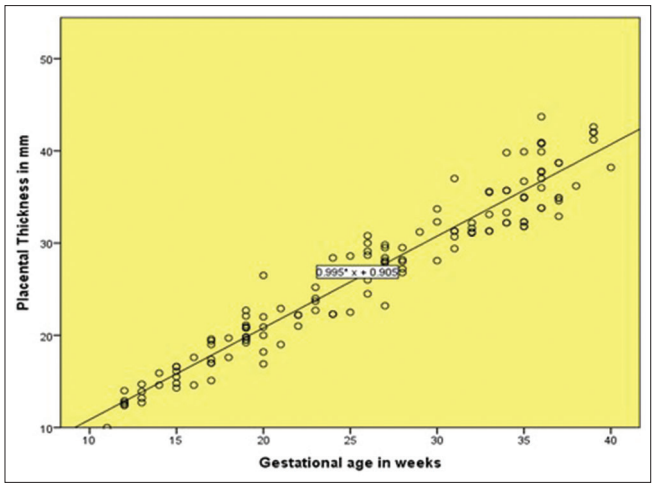

Figure 7: Scatter plot showing simple linear regression relation of GA by ultrasound in weeks and PT in mm with gestational age as independent variable and placental thickness as dependent variable. PT: Placental thickness; GA: Gestational age

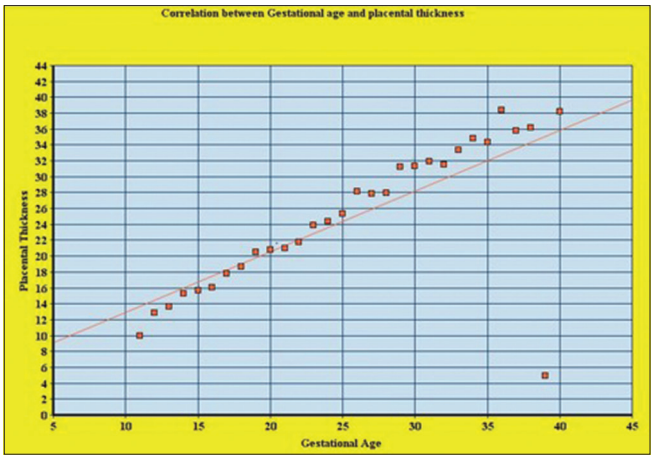

Figure 8: The relationship between mean placental thicknesses (in mm) with increasing gestational age (in weeks) from 11 to 40 weeks is linear and direct. (r^2 = 0.932, P < 0.001), PT = 0.905 + 0.995 × GA. PT: Placental thickness; GA: Gestational age

and P < 0.001 was found.[10] The present study had r = 0.992 and P < 0.001. PT bears a linear relationship until 36 weeks of gestation, after which there is a decrease in the thickness till 40 weeks[10] which is also like our finding except at 39 weeks, where the thickness increased in the case of our study.

The "*in utero*" environment and its impact on neonatal health are of paramount importance in relation to adult health outcomes. The placental localization by ultrasonography, which was introduced by Donald in the year 1865, was a phenomenal step taken toward the exploration of the "*in utero*" environment,[11,12] and thus, PT measurement is an easy, noninvasive parameter that can solve many doubts together. However, the study is a simplified and reasonable approximation of a true placental growth curve,[13] and if the same patient is followed up throughout the pregnancy, then a longitudinal placental growth curve on serial measurements can be taken through the pregnancy, which will be more accurate. Accuracy can be increased with further 3D ultrasonography.

The measurement of PT depends on the competency of the radiologist as well as the understanding of the placental myometrial interface. It predicted that sonologically thick placentae that are >4 cm or 40 mm or >90th percentile is associated with increased perinatal morbidity and mortality and fetal anomalies such as small for GA (SGA) and low birth weight (LBW) infants at term.[14] In the present study, only at 39 weeks of gestation, which comprised four women, the mean PT was 41.95 mm. During the estimation period, however, no fetal anomaly was visible in the anomaly scan. Hellman *et al.*[7] explained in their study that in the past 4 weeks, the thickness of the placenta is reduced because of a reduction in the growth of the placenta. Granum *et al.*[15] reported the linear increase in PT with increasing GA till 33 weeks, after which they

Table 2: Correlation between gestational age and placental thickness

	PT	GA
PT		
R	1	0.966**
Significance (two-tailed)		0.000
N	134	134
GA		
R	0.966**	1
Significance (two-tailed)	0.000	
N	134	134

**Correlation is significant at the 0.01 level (two-tailed). *r*: Pearson correlation coefficient; *n*: Total number of cases; PT: Placental thickness; GA: Gestational age

showed gradual thinning. Berkowitz *et al.*[16] reported a reduction in thickness after 32 weeks. In the present study, the PT showed a reduction from 37 weeks till 38 weeks, after which there was an increase in the 39 weeks of gestation with a mean PT of 42 mm. The thickness again reduced to 38.2 mm in 40 weeks of gestation. Habib in their study said that the PT was 22 mm at 36 weeks in the fetuses which weighed <2500 g after birth, and that the PT was 34.8 mm at 36 weeks in the fetuses which weighed >2500 g after birth. They concluded that PT was a predictor of LBW and SGA infants.[17] In our study, the mean PT at 36 weeks was 38.38 mm. In the present study, the follow-up of the patients until the birth of the baby was not done, but fetal growth until 40 weeks of gestation was as per normal growth pattern since there was no detected intrauterine growth restriction (IUGR) case. From the above discussion, it is evident that a decreased PT can be an indicator of IUGR and can be treated if diagnosed early. Hamidi *et al.*[18] in their study on 200 singleton pregnancies from 18 to 20 weeks of gestation found that PT had a positive correlation with neonatal birth weight (r = 0.18), with a 95% confidence

interval (0.05–0.32). The mean PT they determined was 34.2 ± 9.7 mm. The association between PT, Apgar score <7, or medical comorbidities and neonatal intensive care unit admission was not found. However, their study demonstrated a positive correlation between sonographic PT and the birth weight of the infant born. In the present study too, the extension of the observations can be made by observations of the newborns as replication of the data to predict the neonatal outcome. Balakrishnan and Virudachalam, in their study, found thickness to be 14 mm at 11 weeks and 38 mm at 40 weeks of gestation.[19] In the present study, the mean PT at 11 weeks was 10 mm and at 40 weeks, it was 38.2 mm showing similarities with the study and linear relationship. Elsafi *et al*.,[20] in their study, found that there was a linear relationship between PT and average GA (r^2 = 0.9593). In the present study, similar outcomes with (r^2 = 0.9320) were obtained.

In conclusion, the present study is a cross-sectional one; the antenatal women were studied at a time and not followed up till childbirth. Thus, the PT measurement was not a true placental growth curve as this could only be obtained from the serial measurements and follow-up of the same patient throughout childbirth. The individual growth pattern of the placenta cannot be studied from this. Moreover, the growth, as well as thickness profile, may be influenced by environmental and demographic profiles within a certain population that might include ethnicity. Hence, for a population-specific nomogram, the study should be extended over a longer time in a larger population size. However, the study is a simplified and reasonable approximation of a true placental growth curve.[13] If the same patient is followed up throughout the pregnancy, then only a longitudinal placental growth curve on serial measurements can be taken through the pregnancy. If the same patient is followed up throughout the pregnancy, then only a longitudinal placental growth curve on serial measurements can be taken through the pregnancy.

The measurement of PT depends on the competency of the radiologist as well as the understanding of the placental–myometrial interface. When the placenta is posterior, acoustic shadowing should be prevented as far as possible and since in posterior placenta cord insertion site is difficult to identify, Doppler assistance is a must. In the case of the anterior placenta, to minimize the reverberation artifacts, proper transducer position and gain settings are important. Despite the limitations, the present study had the advantage of being the first of its kind in the Manipuri cohort and it formed a nomogram for the mentioned weeks.

A similar study, if done with follow-up of the mothers in a larger sample size till childbirth and along with consideration of fetal birth weight, postnatal development, and congenital diseases (if any), can provide more conclusive results.

Conclusion

Since, as per the present study, PT (in mm) increased with an increase in GA (in weeks) and almost matched it from 12 to 34 weeks of gestation, it can be an important additional parameter for the estimation of GA apart from other fetal parameters and can substitute BPD in abnormal conditions such as in hydrocephalus, FL in agenesis of the femur. This can also facilitate the detection of cases such as small for GA babies, IUGR, low placental volume, diabetes mellitus, fetal hypoxia, and hydrops fetalis in the early stages.

Ethical clearance

Received from Institutional Research Ethics Board vide Ref number A/206/REB-Comm(SP)/RIMS/2015/268/11/2017.

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Conflicts of interest

There are no conflicts of interest.

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